



## MAIN RING LATTICE, JULY 1986

S. Ohnuma

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Our main ring is a living organism and, as such, it has gone through a number of metamorphoses including the recent double-bypass addition. Undoubtedly, there will be more in the future (not too distant) so that it is highly desirable to have a compilation of this nature as an identifiable report which should be revised from time to time. This report is intended to be the first of a series.

Warning     Do NOT use any numbers here for magnet installations or surveys. Numbers are strictly for generating the linear lattice parameters only.

In the main ring, there are of course numerous correction elements as well as special items such as Lambertson magnets and rf cavities. However, these should be listed in the Main Ring Ministraight Inventory.

Lattice Structures (station numbers)

<u>horizontal</u>	<u>vertical</u>	<u>Comments</u>
	Ø	
	11	12
13		14
15		16
17		18
19		/
/		21
22		23
24		25
26		27
28		29
32		33
34		35
36		37
38		39
42		43
44		45
46		47
48		
	49	
	Ø	
		<p>1. Stations #11 and #49 are neither horizontal nor vertical.</p> <p>2. Stations #17 are all medium-straight. There two dipoles instead of the usual four; at F17, there is only one dipole.</p> <p>3. Stations #48 have three dipoles.</p> <p>4. The following numbers are <u>NOT</u> used as the station number:</p> <p style="margin-left: 40px;">20 30 31 40 41</p> <p>5. Vertically focusing quadrupoles at stations #25 and #43 are <u>all</u> rolled by 10.5 mr each, the wall-side down (Edwards-Stiening Roll).</p> <p>6. Total number of quadrupoles and dipoles:</p> <p style="margin-left: 40px;"><u>Quadrupoles</u></p> <p style="margin-left: 80px;">F: 16x6 = 96</p> <p style="margin-left: 80px;">D: 16x6 = 96</p> <p style="margin-left: 80px;">F': 4x6 = 24</p> <p style="margin-left: 80px;">D': 4x6 = 24</p> <hr style="width: 20%; margin-left: 80px;"/> <p style="margin-left: 80px;">total = 240</p> <p style="margin-left: 40px;"><u>Dipoles</u></p> <p style="margin-left: 80px;">HB: 744</p> <p style="margin-left: 80px;">HB2: 15</p> <p style="margin-left: 80px;">VB2: 12</p> <hr style="width: 20%; margin-left: 80px;"/> <p style="margin-left: 80px;">total = 771</p>

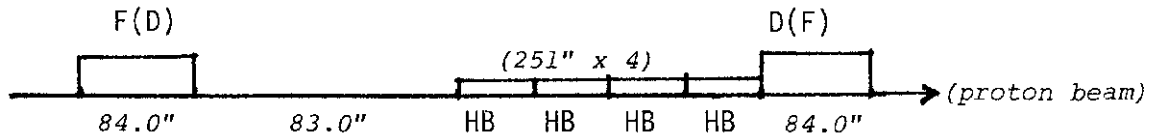
Length of Lattice Elements ( # indicates a station number)

F & D: 7-foot quadrupoles = 84.00" long  
 F' & D': 4-foot quadrupoles = 51.95" long  
 HB: horizontal-bend (239.0") plus 12.0" free space,  
 bend angle =  $2\pi/774$   
 HB2: horizontal-bend (239.0") plus 12.0" free space,  
 bend angle =  $4\pi/774$   
 VB2: mostly vertical-bend (239.0") plus 12.0" free space,  
 bend angle in the bend plane =  $4\pi/774$

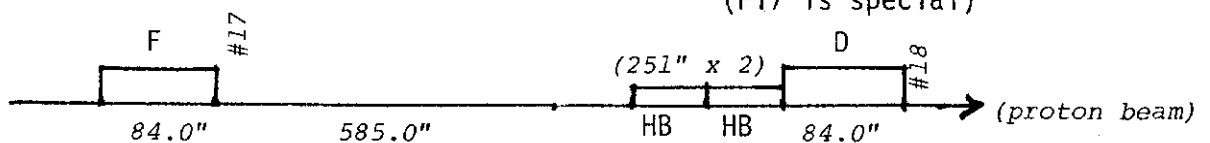
Numbers given here should never be used for magnet installation.

They are meant to be used for generating linear parameters of the ring.

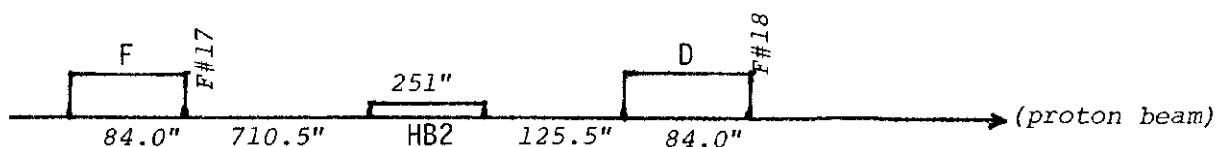
1. normal half cell (one quadrupole & four dipoles)



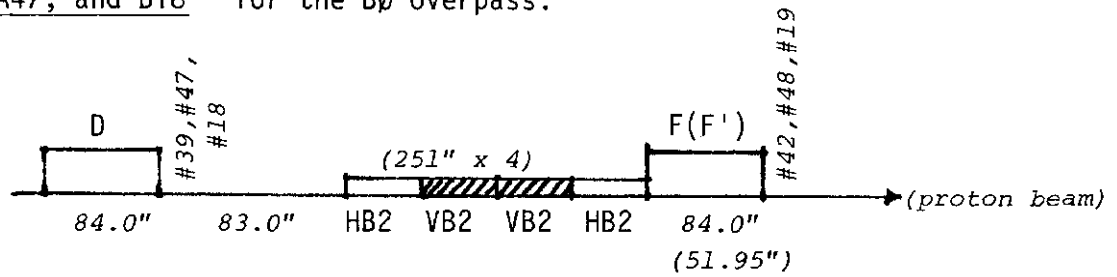
2. medium-straight (one quadrupole & two dipoles); stations #17  
 (F17 is special)



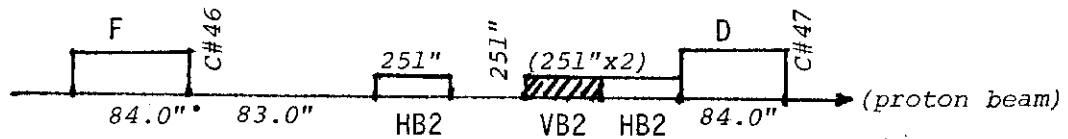
3. F17, medium-straight (one quadrupole & one dipole)



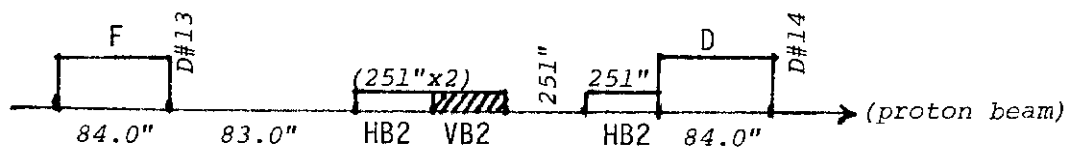
4. A39, A47, and B18 for the BØ overpass.



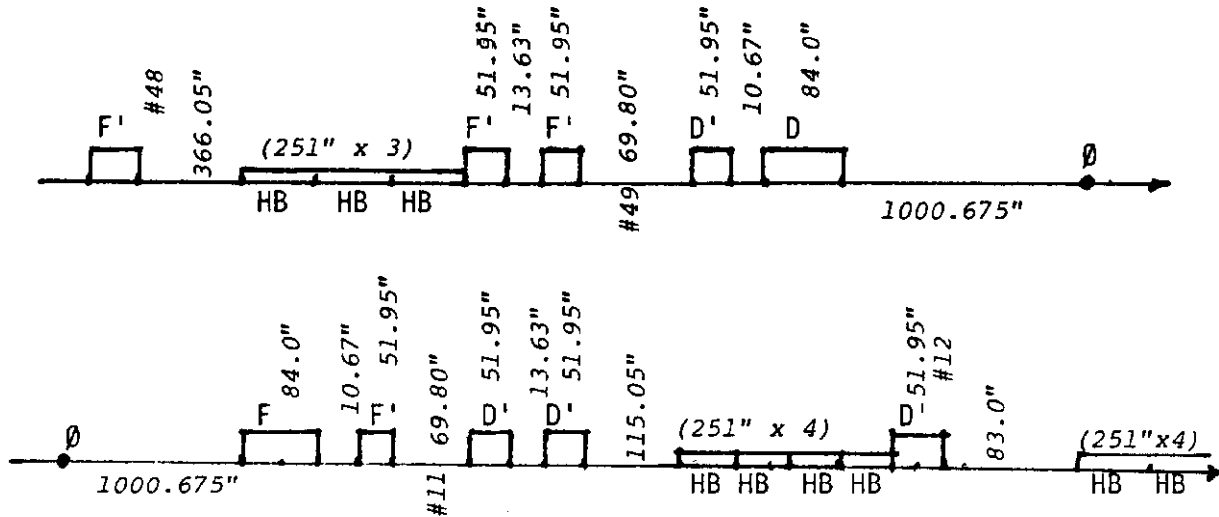
5. C46 for the DØ overpass.



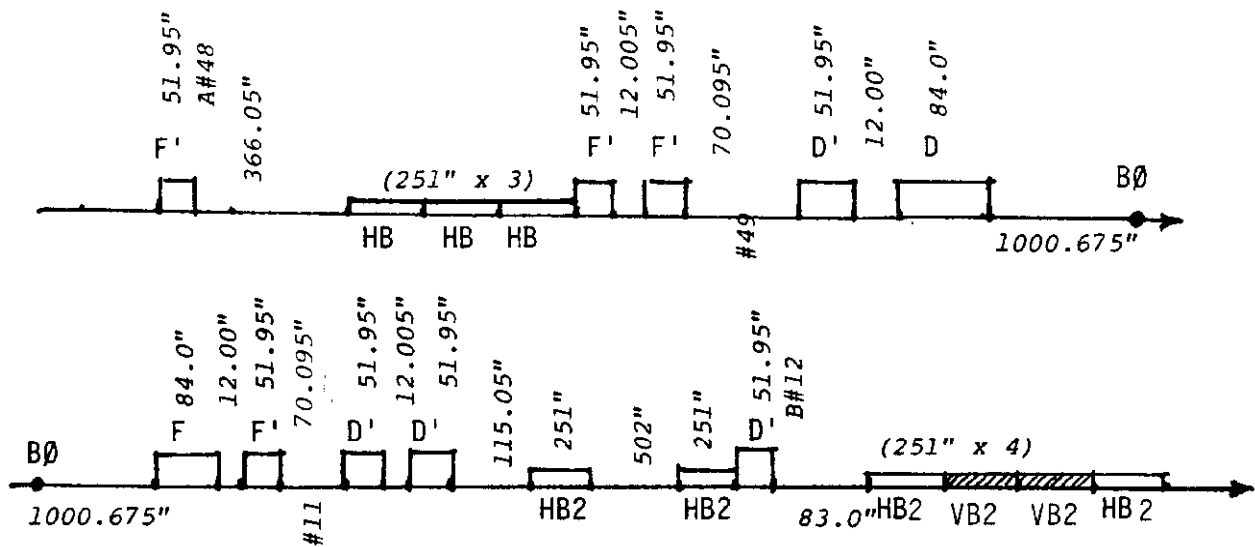
6. D13 for the DØ overpass.



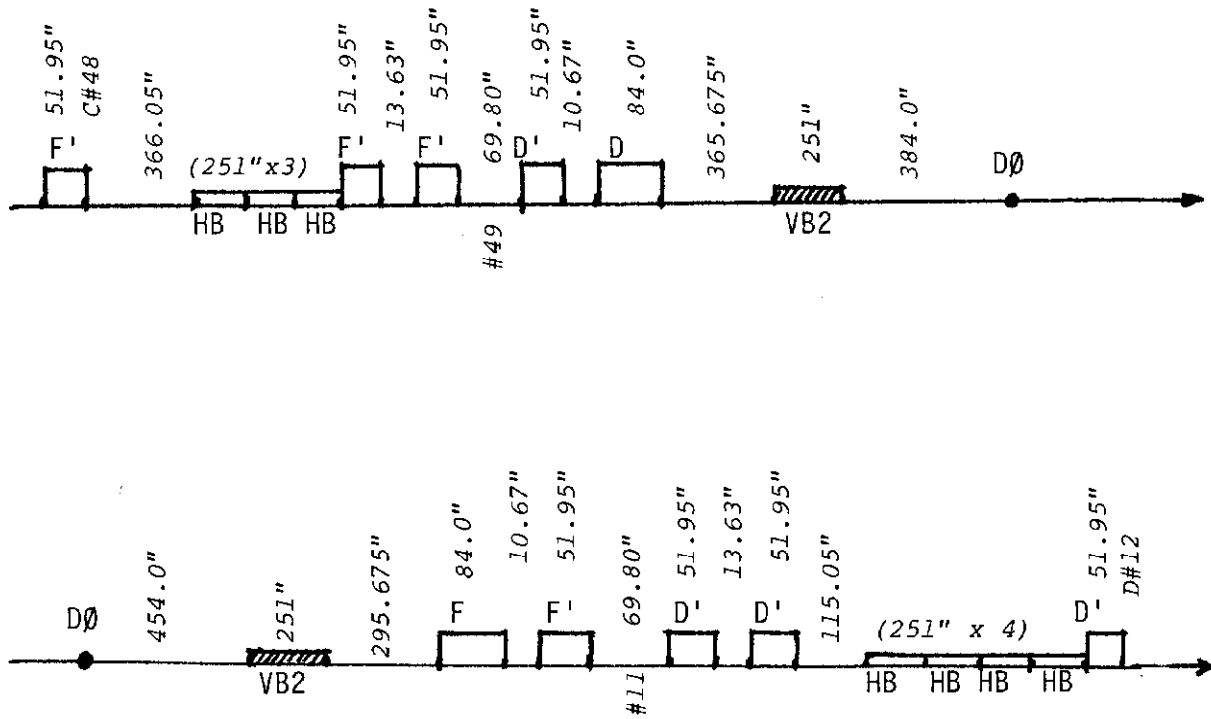
7. AØ, CØ, EØ, and FØ (from stations #48 to #12)



8. BØ (from A#48 to B#12); BØ overpass.



9. DØ (from C#48 to D#12): DØ overpass.



- Ode to the Main Ring -

"Age cannot wither her, nor custom stale

Her infinite variety; ..... "

- Enobarbus -

## Rotation of Coordinates for Overpass Dipoles

In order to calculate the transverse 4x4 matrix properly through the overpass dipoles, one must rotate the transverse (x-y) coordinates by a certain angle before (entrance) and after (exit) for each dipole. This means that the sequence would be

(rotate, entrance)-(dipole)-(rotate,exit)-(rotate,entrance)-(dipole)-  
-(rotate,exit)-(rotate, entrance)-(dipole)- .....

Note that, for horizontal-bend dipoles, the entrance and the exit angles are identical. Do NOT change the sign!

rotation matrix with angle (entrance or exit)  $\alpha$  (in radians)

$$C \equiv \cos(\alpha) \quad \text{and} \quad S \equiv \sin(\alpha)$$

$$\begin{pmatrix} C & 0 & S & 0 \\ 0 & C & 0 & S \\ -S & 0 & C & 0 \\ 0 & -S & 0 & C \end{pmatrix} \begin{pmatrix} x \\ x' \\ y \\ y' \end{pmatrix}$$

### I. BØ overpass

	entrance	exit	
A#39-2 (HB2)	0	0	
-3 (VB2)	-1.46146	+1.46144	
-4 (VB2)	-1.46147	+1.46143	
-5 (HB2)	-0.00026	-0.00026	
A#42-2 to A#46-5 (HB)	-0.00013	-0.00013	
A#47-2 (HB2)	-0.00026	-0.00026	
-3 (VB2)	+1.68312	-1.68308	(all in radians)
-4 (VB2)	+1.68311	-1.68309	
-5 (HB2)	0	0	
A#48-3 to B#12-2 (HB & HB2)	0	0	
B#12-3 (VB2)	+1.68355	-1.68356	
-4 (VB2)	+1.68353	-1.68358	
-5 (HB2)	+0.00026	+0.00026	
B#13-2 to B#17-5 (HB)	+0.00013	+0.00013	

	entrance	exit
B#18-2 (HB2)	+0.00026	+0.00026
-3 (VB2)	-1.46108	+1.46112
-4 (VB2)	-1.46109	+1.46111
-5 (HB2)	0	0

## II. DØ overpass

	entrance	exit
C#46-2 (HB2)	0	0
-4 (VB2)	-1.32930	+1.32927
-5 (HB2)	-0.000128	-0.000128
C#47-2 to C#48-5 (HB)	-0.000064	-0.000064
inner pair, upstream (VB2)	+1.81232	-1.81229
inner pair, downstream (VB2)	+1.81370	-1.81373
D#11-2 to D#12-5 (HB)	+0.000064	+0.000064
D#13-2 (HB2)	+0.000128	+0.000128
-3 (VB2)	-1.32907	+1.32910
-5 (HB2)	0	0

Since the local transverse coordinates are always defined by quadrupoles, there is no need to rotate the coordinates before or after quadrupoles.